Title:

Integrated System Test

PROCEDURE

for the

XMM Experiment

OM-FM

	Prime Contractor	Signature/Date	Customer	Signature/Date
Originator	R. Schricke			
Checked By	T.Kaufungen			
Product Assurance:	U.Gageur			
Project Management:	U.Minne			

DRL:_____

<u>CHANGE LOG</u>

Issue	Date	Sheet	Description of Change	Release
draft	20.01.98	all	draft layout	
2	14.4.99	All	Update for FM	

Table of Contents

1. SCOPE OF PROCEDURE

This is the Integrated System Test (IST) procedure for the *OM* Experiment.

It's scope is to verify

- all *OM* experiment functions and performance
- all functional interfaces within the experiment and to the S/C

after the experiment has been successfully integrated into the XMM S/C.

The procedure defines:

- the test conditions
- necessary test preparation steps
- step by step test sequence for each test case
- necessary post processing and evaluation steps

Each test case and each test step contains fields to note the pass/fail result and all relevant information occurring during the test.

When testing has been completed, the filled-in test procedure will establish the sub-system Test Report.

Please note, that this version of the document is based on XMM-OM/MSSL/SP/0194.7. It comprises, however, additional changes which are not contained in that reference document. These changes are highlighted by **bold characters**.
Please note further, that the High Voltage test sequences (Imaging Full Frame and Multiple Image, Test Sequence 11 and 12) will not be performed as part of the nominal IST.

2.   APPLICABLE DOCUMENTS

In the event of conflict between higher level documents referenced and this test procedure, the higher level documents shall have precedence.

2.1.   General Documents

- XOIRD
- PX-RS-0023
- EID-B's
- System Verification Programme Plan
- Configuration Management Plan
- Environmental Design and Test Requirements Specification
- XMM Users Manual (XUM)
- AIT and Resources Plan
- Product Assurance Requirement Specification
- XMM-OM/MSSL/SP/0194.7, April 99 (OM-FM Integrated Functional Test Procedure)
- XMM-OM/MSSL/SP/0169.2, 4.7.98 (Acceptance Data Package)

2.2. Documentation in Checkout Area

Following documentation must be available in the C/O area during the IST:

- SAS Operation and Maintenance Manual
- TT&C SCOE Users Manual
- AOCS SCOE Users Manual
- BAT SCOE Users Manual
- PYRO SCOE Users Manual
- OCOE Functional Test Procedure
- FPA SCOE Users Manual

- OBDH Frontend Users manual

  .

3. DESCRIPTION OF TEST OBJECTIVE

The **OM** IST shall demonstrate that the experiment and its interfaces are working together as an integral part of the spacecraft by verifying all experiment functions, its performance, and the functional interfaces.

The test is split into test cases as shown below. Each of the cases is run by a Test Sequence, which may call lower level Test Sequences. Detailed information on the individual Test Sequences may be found in the EGSE User Manual.

This IST comprises:

- all experiment functions and performance
- all functional interfaces within the experiment and towards the S/C
- tests on all redundant or cross strapped branches
- end to end verification of all sensors including sensor external stimulation and polarity checks
- experiment power consumption for each operating mode**.**

The *OM* test cases must be run in the prescribed order. The order in which they are run must be recorded in the test execution summary sheet.

Test Cases which cannot be executed due to missing of other H/W or S/W on the S/C, because they are not yet integrated at this stage of the AIT programme, shall be identified and will be conducted during the so-called Delta IST.

3.1. Description of Test Flow for FM

3.1.1. Test Sequence 1: Switch-on (prime or redundant)

Description
Switch-on procedure for the OM (prime or redundant).
Switch-on the OM prime power and prime keep-alive line and check for HK data

Initial state
The OM is switched off (KAL prime can be on).

Final State
The OM (prime or redundant) is switched on and in basic mode.

Safety precautions
The Filter wheel is a limited life time device. Each rotation of the filter wheel (which occurs every time the OM is switched on) must be recorded in the instrument log book for the flight model.

3.1.2. Test Sequence 2: Basic Mode Test

Description
The function of the OM is tested in the basic mode test without loading the main application software (operational mode).
Dump IC memory and verify the operation of the KAL memory.

Initial state
The OM (prime or redundant) is switched on and in basic mode

Final State
The OM (prime or redundant) is switched on and in basic mode.

Safety precautions
none

3.1.3. Test Sequence 3: DMA Test

Description
This test verifies that data can be loaded via low level patch and dump commands.

Initial state
The OM (prime or redundant) is switched on and in basic mode

Final State
The OM (prime or redundant) is switched on and in basic mode.

Safety precautions

3.1.4. Test Sequence 4: Time Synchronisation Test

Description
This test verifies the time synchronisation between CDMU and OM.

Initial state
The OM (prime or redundant) is switched on and in basic or in operational mode.

Final State
The OM (prime or redundant) is switched on and in the same mode as in the initial state.

Safety precautions
none

3.1.5. Test Sequence 5: Operational Mode Test

Description
The function of the OM is tested in the operational mode test.
Switch on secondary rail of OM-1 and test operation.
Test operation of DPU.

Initial state
The OM (prime or redundant) is switched on and in basic mode.

Final State
The OM (prime or redundant) is switched on and in operational mode.

Safety precautions
None

3.1.6. Test sequence 6: Filter Wheel Control Test

Description
The function of the OM filter wheel operation is tested in operational mode.
Command search for coarse sensor.
Command search for datum position.

Initial state
The OM (prime or redundant) is switched on and in operational mode

Final State
The OM (prime or redundant) is switched on and in operational mode with filter wheel in datum position.

Safety precautions
The Filter wheel is a limited life time device. Each rotation of the filter wheel must be recorded in the instrument log book for the flight model.

3.1.7. Test sequence 7: Dichroic Control Test (beam deflector)

Description
The function of the OM dichroic (beam deflector) is tested in engineering mode
Command dichroic to rotate to redundant.
Command dichroic to rotate to prime.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).

Final State
The OM (prime or redundant) is switched on and in idle mode. The dichroic is at 'prime' interface position.

Safety precautions
This test procedure should be reviewed by OM personnel before first execution.

The Dichroic is a limited life time device. Each movement of the dichroic wheel must be recorded in the instrument log book for the flight model instrument.

3.1.8. Test sequence 8: Heater Control Test

Description

The function of the heaters is tested in operational mode.
Each of the four main heaters are cycled on/off in turn.

Initial state
The OM (prime or redundant) is switched on and in operational mode.

Final State
The OM (prime or redundant) is switched on and in operational mode.

Safety precautions
None

3.1.9. Test sequence 9: Image Acquisition Test - Multiple Window (High Voltage OFF)

Description
The function of the OM Image acquisition is tested in operational mode.
A full image will be acquired and dumped to the instrument workstation. Only those areas enabled in the window table should contain events.

Initial state
The OM (prime or redundant) is switched on and in an operational mode.
OM-1 secondary rails are switched on.

Final State
The OM (prime or redundant) is switched on and in idle mode.

Safety precautions

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

3.1.10. Test sequence 10: Image Acquisition Test - Full Frame (High Voltage OFF)

Description
The function of the OM Image acquisition is tested in engineering mode.
A full frame image will be acquired and dumped to the instrument work station.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.

Final State
The OM (prime or redundant) is switched on and in engineering mode.

Safety precautions

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

3.1.11. Test sequence 11: Image Acquisition Test - Multiple Window (High Voltage ON)

Description
The function of the OM Image acquisition is tested in operational mode.
A full image will be acquired and dumped to the instrument workstation. Only those areas enabled in the window table should contain events.

Initial state
The OM (prime or redundant) is switched on and in an operational mode.
OM-1 secondary rails are switched on.

Final State
The OM (prime or redundant) is switched on and in idle mode.

Safety precautions
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

3.1.12. Test sequence 12: Image Acquisition Test - Full Frame (High Voltage ON)

Description
The function of the OM Image acquisition is tested in engineering mode.
A full frame image will be acquired and dumped to the instrument work station.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.

Final State
The OM (prime or redundant) is switched on and in engineering mode.

Safety precautions
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

3.1.13. Test sequence 13: Switch-off

Description
Mode and state are checked and the appropriate procedure is followed to switch-off in an orderly way.

Initial state
The OM (prime or redundant) is switched on.

Final state
The OM (prime or redundant) is switched off. The KAL power lines may be left on.

Safety precautions
none

4.   NCR AND SCR STATUS LIST

NCR No.	NCR Title	Reference Paragraph	Open Date	PA

SCR No.	SCR Title	Reference Paragraph	Open Date	PA

5.   PROCEDURE VARIATION SHEET

Paragraph	Description of Variation (Reference to Continuation sheets)	Signatures			Action Required (Reference to NCR)
		TC	PA	ESA	

6.   TEST PROCEDURE

General:
> All test activities shall be performed in accordance with the test procedure.

Procedure Variation Sheet:
> Any change to the approved procedure shall be only recorded on the procedure variation sheets and approved by the test conductor. All changes shall be justified and agreed prior to the event and last minute changes shall be discovered. All change requests shall be subject to configuration control, if flight H/W or S/W is involved.

PA-Requirements:
> During the test activities strict PA control must be applied. Strict adherence to the procedure shall be verified by PA inspection.

Non Conformance Reports (NCR's):
> Any anomaly or discrepancy between procedure and results shall be the cause of a NCR. The NCR must be raised immediately and a MRB must be held before the test can be continued. Each NCR have to be noted in the NCR Table in chapter 5.
>
> Also the discrepancies which are thought to be caused by software, shall be dealt with NCR's.

Preparation of Tests:
> Prior to the start of any test, the contractor must ensure that:
> - The test procedure is reviewed and approved by ESA.
> - all necessary GSE is available, test instrumentation properly installed and calibrated, and test facility ready and in good working condition. Any log books kept up to date.
> - the test configuration with all necessary MGSE/EGSE properly established
> - all test personal are ready and proper precautions are taken to avoid accidents which may be harmful to personnel and/or the spacecraft.

Execution of Tests:
> During the test, the test conductor shall ensure that:
> - the test proceeds according to the procedure
> - all communications between the test personal are routed through the accepted communication channels and are in the agreed working language of the project
> - deviations from the procedure can only be made when a signed off Procedure Variation Sheet or a NCR/MRB disposition can be presented, otherwise PA has the right to stop the test. To avoid any critical status of the system under test, a sequence must be available to bring the system in a non-critical status until the situation has be cleared. A non-conformance-report has to be raised, if the procedure is not to be followed.
> - There is continuous monitoring of the S/C status by QA personnel and the test conductor of his substitute at any time the S/C is switched ON.
> - At test step execution the version/revision number and the checksum of the Test Sequences shall be noted down together with the start/end time.
> - The OK / NOT OK status shall be noted for each step

- Anomalies during test run (e.g. errors, TS halts, etc.) shall be recorded
- All relevant TS printouts, log files, plots, etc. have to be added.

Conclusion of Tests:

At the completion of the test, the test conductor must ensure that:
- all steps in the procedure are completed
- all steps required for the Post Processing are performed
- all necessary printouts for the test report are collected
- no action remaining open through NCR's that would invalidate the successful completion of the test.
- all responsible engineers sign the declaration sheet

Test Reviews:

Prior to the (but after preparation) and after IST´s and Mission Simulation, test readiness reviews (TRR) and post test reviews (PTR) shall be held. The purpose of the reviews is to ensure, that the conditions and requirements are met.

During the test, all test related directions or replies have to be given through the intercommunication system of the OCOE in English language, chaired by the test conductor or his substitute who fills in the master procedure.

6.1. General Test Conditions Applicable to all Test Cases.

Checkout Room

Environmental	Nominal	Actual	P	N
Cleanliness	ambient			
Temperature	17-23°C			
Relative Humidity	40-60°%			
Pressure	Ambient			

Clean Room

Environmental	Nominal	Actual	P	N
Cleanliness	100.000			
Temperature	17-23°C			
Relative Humidity	40-60°%			
Pressure	Ambient			

Mechanical:

During Experiment testing , any movement of MGSE is not allowed.

Electrical:

6.1.1.   SVM - EGSE Configuration
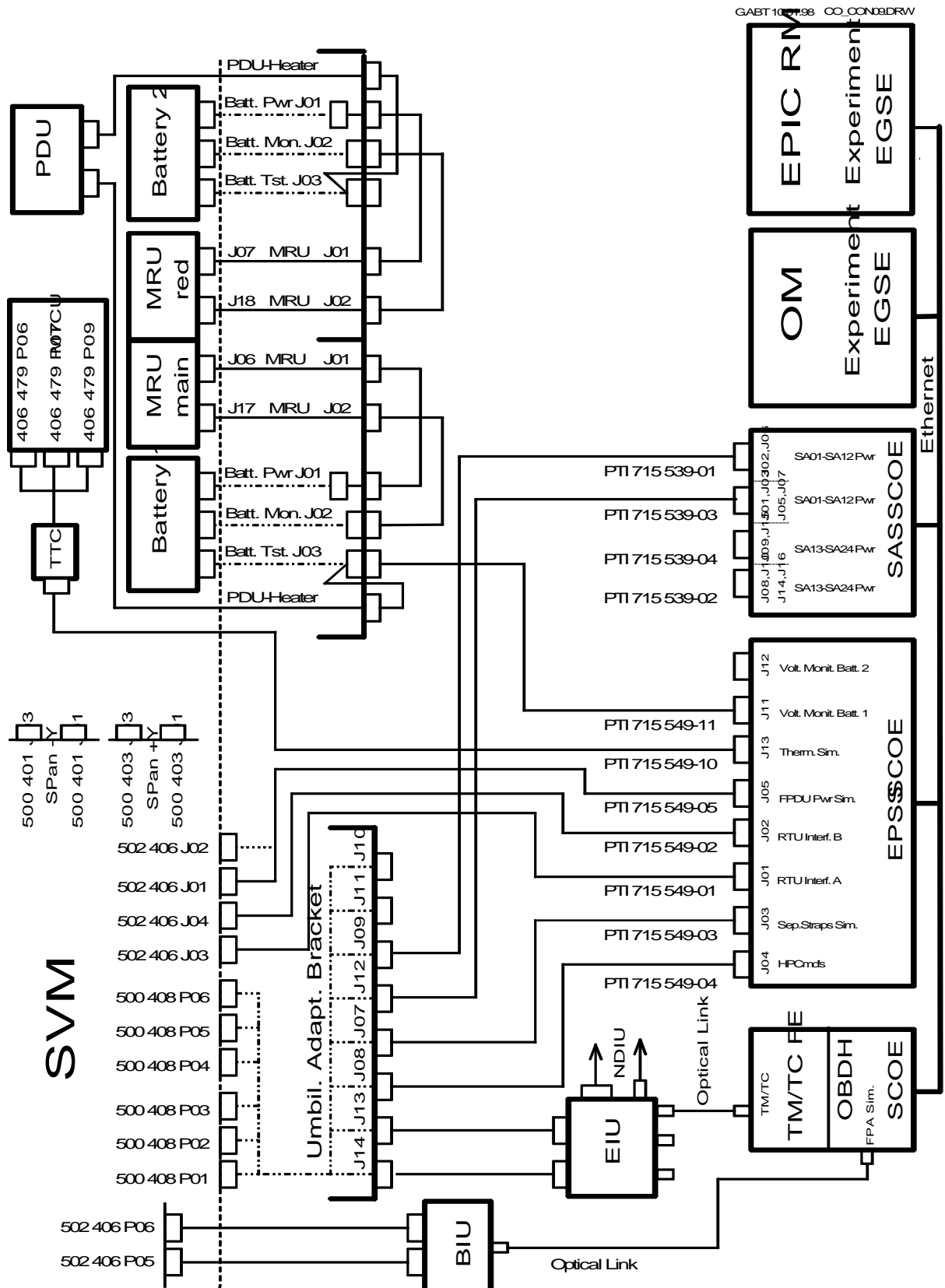
6.1.2. FPA - EGSE Configuration

Not applicable for FM

6.1.3. EGSE S/W setup + configuration

The S/W configuration used for this test is documented in :

XM-PR-DOR-0049   issue:

6.1.4. S/C Configuration

The spacecraft has to be switched to   **'Basic Test Mode'.**

Run Control File: ***'X_MOD_OFF2BTM'***

The exact as-built configuration status of the S/C with all serial numbers, etc. as maintained by PA shall be attached to section 8.

6.1.5. Special Test Equipment

All necessary test equipment (S/W & H/W) are listed in the following tables:

No.	Item	Manufact.	Model No.	Serial No.	Inv./PTI No.	Next Calibration

6.1.6. Safety Precautions

- The handling of the test set-up shall be in accordance with controlled procedure only

- Handling, mechanical and electrical, has to be done only by qualified personnel as defined in the AIT-Plan.

- All connectors have to be covered with dust caps when not mated.

- All optical sensors shall be protected by covers except when stimulated.

- Pyrotechnic devices are only installed when unavoidable and in safe condition.

- Test item has to be switched-off when changing Test Configuration.

- All test personnel which must have access to the S/C, have to wear anti static shoes and clothes.

- The cleanroom floor around and under the item under test shall be covered with an anti static carpet, which is grounded to facility ground. Not applicable for Dornier Integration Facility which provides conductive floor.

- **Radioactive Sources**
  n/a for OM

- **Pyrotechnics**
  Safe/Arm Plugs at the Skin Connector Bracket are exchanged against Pyro Pulse Detector Harness.

6.2. TestSequence 0:   Configuration of OM and EGSE for IST

This test is performed automatically by executing the Test Sequence:

EHM_CONFIG

6.2.1.   Test Description

Description
This sequence configures the EGSE for the test and allows to select for prime or redundant side of the OM experiment operation. The test sequence is alos used to make seetings for the Radiation Monitor experiment but these settings will be disregarded in the subsequent IST test steps for this OM IST.

Initial state
The S/C is switched to Basic Test Mode BTM

Final State
Same as initial state.

Safety precautions
None

6.2.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel
> (e.g. Test Manager) **MUST** be consulted, before the test is
> resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.2.3.   Execution: Configuration Sequence

execute:.EHM_CONFIG.TS

6.2.4. Testresult Prime Branch   EHM_CONFIG

Date	Expected Time	Start Time	End Time	Test Executed
	5 min			**OK NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.2.5. Testresult Redundant Branch EHM_CONFIG

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.3. TestSequence 1 :   Switch-On (Prime or Redundant)

This test is performed automatically by executing the Test Sequence:

EHMOD_PWR_ON

6.3.1.   Test Description

Description
Switch-on procedure for the OM (prime or redundant).
Switch-on the OM prime power and prime keep-alive line and check for HK data

Initial state
The OM is switched off (KAL prime can be on).

Final State
The OM (prime or redundant) is switched on and in basic mode.

Safety precautions
The Filter wheel is a limited life time device. Each rotation of the filter wheel (which occurs every time the OM is switched on) must be recorded in the instrument log book for the flight model.

6.3.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> ### WARNING!
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.3.3. Execution: Switch On Prime/Redundant

execute:.EHMOD_PWR_ON.TS

Step	Action	TC/TM	Remarks	Prim	Red
0	Initial State: OM 28V power switched off KAL line on				
1 1.1 1.2 1.3	Switch-on OM power Switch-off the S/C heater (if not switched off before) Switch-on 28V Switch-on KAL (if not switched on before)		Filter wheel to coarse S/C procedure S/C procedure S/C procedure		
2 2.1 2.2 2.3	Check Housekeeping Ensure HK monitor prog working Verify basic mode is operational Verify heaters are on Secondaries disabled	90000	(HK Valid after 15 second) pref H5395 = 'Initial' pref H5240 ='ononoffoff' pref H5255 = 'Disabled'		
3 3.1 3.2 3.3	OM power measure OM +28V voltage and current Measure OM KAL voltage and current Compare with table 5.0-1		S/C procedure report: voltage and current S/C procedure report: voltage and current		
4	Exit				

Power line	Voltage	Current
+28V main power	+28V +/- 2V	1880mA +/- 50mA
Keep Alive Line	+8V +/- 1V	<18mA

Table 5.0-1: OM power consumption (basic mode)

6.3.4. Testresult Prime Branch   EHMOD_PWR_ON

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.3.5. Testresult Redundant Branch EHMOD_PWR_ON

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.4. Test Sequence 2: Basic Mode Test

This test is performed automatically by executing the Test Sequence:

EHMOD_BOOT_TEST

6.4.1. Test Description

Description
The function of the OM is tested in the basic mode test without loading the main application software (operational mode).
Dump IC memory and verify the operation of the KAL memory.

Initial state
The OM (prime or redundant) is switched on and in basic mode

Final State
The OM (prime or redundant) is switched on and in basic mode.

Safety precautions
none

6.4.2. Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> ### WARNING!
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.4.3. Execution: Basic Mode test

execute: EHMOD_BOOT_TEST.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial State: OM is switched on and in basic mode KAL power line is on				
1	Check test command				
1.1	Send invalid command (tc_send)	TC(0,0)			
1.2	Check packet response	91202	TM (3,2)		
1.3	Check HK (bad TC counter)	90000	Pref H5390 = 1		
1.4	Send valid command (tc_test)	H1			
	Check packet response	91100	TM (3,1)		
	Check HK	90000	Pref H5385 = 1		
1.5	Send invalid sub-type (5,15)	TC(5,15)	TM 91203		
1.6	Send wrong checksum		TM91201		
1.7	Perform Time Synchronisation test				
2	Prompt operator to perform test : Dump and verify KAL is OK				
2.1	Dump instruction space				
2.2	Address 0x3800 = Start	H4101	H500 = 0x3800		
2.3	Length = 20 (14 Hex) Words		H510 = 0x14		
2.4	Compare contents: 85D0, **4A04**, 8320, 0906, B122 4820, 400E, 4800, 4009, 8520, DD40, 4820, 2000, 4810, 2002, B700, 0D00, 0D02, 0D04, 85F0	94201	**ICU S/W issue 8 only**		
3	IF memory contents is O.K the goto section **6.7.3**, step 1.3. If memory contents is incorrect goto section **6.7.3**, step 1.1.		If KAL OK skip ICU load IF KAL bad re-load ICU		

6.4.4. Testresult Prime Branch EHMOD_BOOT_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.4.5. Testresult Redundant Branch EHMOD_BOOT_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.5. Test Sequence 3: DMA Test

This test is performed automatically by executing the Test Sequence:

EHMOD_DMA_TEST

6.5.1. Test Description

Description
This test verifies that the CDMU can perform low level patch and dump on the OM memory. Please note, that the S/W patch which is uploaded in this test sequence is not only used for test purposes but is necessary to enable the OM to accept commands without CRC.

Initial state
The OM (prime or redundant) is switched on and in basic mode

Final State
The OM (prime or redundant) is switched on and in basic mode.

Safety precautions
none

6.5.2. Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.5.3. Execution: DMA Test

execute: EHMOD_DMA_TEST.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and KAL power line is on		**Pref H4505 = 'Basic'**		
0.1	Disable watchdog in preparation for RBI suspend	H6510			
1	Ensure that telecommand checksumming is disabled		EGSE procedure		
2	Check command reception				
2.1	Send tc test command	H1	Test-command w.o. CRC		
2.2	Check packet response	91201	Incorrect checksum		
3.	**Enable Telecommand checksumming**		**EGSE procedure**		
4.	Upload patch software				
4.1	Send RBI suspend command	**D7203**			
4.2	Load patch 5.2-1	*raw-com.*	**C42=0x76E52,C43=10**		
4.3	Dump and compare patch 5.2-1	**D3921**			
4.4	Load patch 5.2-2	*raw-com.*	**C42=0x73C18,C43=2**		
4.5	Dump and compare patch 5.2-2	**D3921**			
4.6	Send RBI go command	**D7204**			
4.7	**Enable watchdog**	**H5510**			
4.8	**Check packet response**	**91100**	Packet accepted		
4.9	Dump & compare patch 5.2-1	H4101	Address = 3729 (hex) Length = 10 (dec)		
4.10	Dump & compare patch 5.2-2	H4101	Address = 1E0C (hex) Length = 2		
5	**Ensure that telecommand checksumming is disabled**		**EGSE procedure**		
6	Check command reception				
6.1	Send tc test command	H1	Test-command w.o. CRC		
6.2	Check packet response	91100	Packet accepted		
6.3	**moved to 4.7**				
6.4	**moved to 4.8**				
7.	**Enable Telecommand checksumming**		**EGSE procedure**		
8	Exit				

Please note that the test command in step 2.1 must be rejected due to missing CRC. After uploading the S/W patch in step 4 the test command in step 6.1 shall be accepted.

Value
E522
800D
0003
4A07
3000
7503
7200
0655
7070
1E0E

Table 5.2-1 Non-volatile Patch

Value
7070
3729

Table 5.2-2 Volatile Patch

Notes: S/C procedures

The values for the commands for the spacecraft procedures are as follows:

1. TC(6,1), APID 129, MID = 2, Address =0007 6E52 (hex)
2. TC(6,2), APID 129, MID = 2, Address = 0007 6E52 (hex), length = 10 (dec)
3. TC(6,1), APID 129, MID = 2, Address = 0007 3C18 (hex)
4. TC(6,2), APID 129, MID = 2, Address = 0007 3C18 (hex), length = 2

6.5.4. Testresult Prime Branch   EHMOD_DMA_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.5.5.   Testresult Redundant Branch EHMOD_DMA_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.6. Test Sequence 4:   Time Synchronisation Test

This test is performed automatically by executing the Test Sequence:

E_MOD_SYNCTIME

6.6.1.   Test Description

Description
This test verifies the time synchronisation between CDMU and OM.

Initial state
The OM (prime or redundant) is switched on and in basic or in operational mode.

Final State
The OM (prime or redundant) is switched on and in the same mode as in the initial state.

Safety precautions
none

6.6.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.6.3. Execution: Time Synchronisation Test

<div style="border:2px solid black; text-align:center;">

execute: E_MOD_SYNCTIME.TS

</div>

(See attached pages)

After execution of the procedure E_MOD_SYNCTIME the following steps shall be performed via keyboard commands:

Step	Action	TC/TM	Remarks	Pass	Notes
1	Enable SID90	H2003	Pref H1200 = 0x90		
2	Wait 20 seconds				
3	Check coarse time of ICU and DPU heartbeat timestamp	92220	pref H7680 (divide by 1024 and compare)		
4	Disable SID 90	H2004	Pref H1200 = 0x90		

6.6.4. Testresult Prime Branch   E_MOD_SYNCTIME

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.6.5. Testresult Redundant Branch E_MOD_SYNCTIME

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.7. Test Sequence 5:   Operational Mode Test

This test is performed automatically by executing the Test Sequence:

EHIST_OPERATION

6.7.1.   Test Description

Description
The function of the OM is tested in the operational mode test.
Switch on secondary rail of OM-1 and test operation.
Test operation of DPU.

Initial state
The OM (prime or redundant) is switched on and in basic mode.

Final State
The OM (prime or redundant) is switched on and in operational mode.

Safety precautions
None

6.7.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> ### WARNING!
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.

Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.7.3.   Execution: Operational Mode test

execute:.EHIST_OPERATION.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in basic mode KAL power line is on				
1	Switch to operational mode				
1.1	Load main operational code (< load_icu)	91100	File : 'load ICU'		
1.2	Check HK packet counter has increased by **494**.	90000	Pref H5385 = ++1FC (hex) Pref H5390 = 1(hex)		
1.3	Start Operational mode Wait 20 s.	H9001	Pref H550 = 0,H650 = 0		
1.4	Verify operational mode started	90000	Pref H5395 = 'Safe'		
1.5	Send test packet	H1			
1.6	Check TM received (verify in operational mode)	91100			
1.7	Send invalid type (15,3)	TC (15,3)			
	Check TM received	TM91202	H6015=15,H6020=3		
1.8	Send invalid sub-type	TC(5,15)			
	Check TM received	TM91203	H6015=5,H6020=15		
1.9	Send wrong checksum				
	Check TM received	TM91201			
1.10	**Enable SID FF**	**H2003**	**H1200=0xFF**		
2	Verify OM-1 secondary rails on				
2.1	Measure OM +28V voltage and current		S/C procedure report: voltage and current		
2.2	Compare with table **5.4-3**				
3	Check Housekeeping	90000			
3.1	+25V secondary rail current		Compare values with table 5.4-1 for prime or table 5.4-2 for redundant		
3.2	+15V secondary rail current				
3.3	+11V secondary rail current				
3.4	+5.3V secondary rail current				
3.5	-5.3V secondary rail current				
3.6	-15V secondary rail current				
3.7	RBI status		Pref H5340 = 1014 (hex)		
3.8	Perform Time Synchronisation test				
4	Test DPU (start-up sequence)				
4.1	Send DPU reset (tc_reset_dsp)	H7201			
4.2	Check TC received	91100 92201	'Packet accepted' DA_DPU_BOOT_READY		
4.3	Examine HK heart beat count	90000	Pref H5410 (incrementing every 10 seconds)		
	Only for full functional test ….				
4.4	Load DPU code procedure (< load_dpu **947** packets)		Ref: DPU Load Script		
4.5	Send Load DPUOS	H7202			
4.6	Check TC Received	91100 92202	'Packet received' 'DPU OS ready'		

1: Step 4.4, 4.5 and 4.6 should only be followed when performing a full functional test.

Rail	PREF	Value
+25V secondary	H5280	16mA < n < 23mA
+15V secondary	H5285	39 mA < n < 54mA
+11V secondary	H5290	87mA < n < 96mA
+5.3V secondary	H5295	393mA < n < 541mA
-5.3V secondary	H5300	368mA < n < 506mA
-15V secondary	H5305	43mA < n < 60mA

Table 5.4-1 Prime Secondary Currents

Rail	PREF	Value
+25V secondary	H5280	15mA < n < 22mA
+15V secondary	H5285	36Ma < n < 50mA
+11V secondary	H5290	77mA < n < 107mA
+5.3V secondary	H5295	391mA < n < 539mA
-5.3V secondary	H5300	360mA < n < 495mA
-15V secondary	H5305	41mA < n < 58mA

Table 5.4-2 Redundant Secondary Currents

Power Rail	**Voltage**	**Current**
+28V line	+28V +/- 2V	**810 (offoffoffoff) - 2550 (ononoffoff) +/-50**
Keep Alive Line	+8V +/- 1V	8mA +/- 5mA

Table 5.4-3 OM power consumption (with OM-1 secondaries on)

6.7.4.   Testresult Prime Branch   EHIST_OPERATION

Date	Expected Time	Start Time	End Time	Test Executed
	20 min			**OK NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.7.5. Testresult Redundant Branch EHIST_OPERATION

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.8. TestSequence 6 : Filter Wheel Control Test

This test is performed automatically by executing the Test Sequence:

EHIST_FWL_TEST

6.8.1. Test Description

Description
The function of the OM filter wheel operation is tested in operational mode.
Command search for coarse sensor.
Command search for datum position.

Initial state
The OM (prime or redundant) is switched on and in operational mode

Final State
The OM (prime or redundant) is switched on and in operational mode with filter wheel in datum position.

Safety precautions
The Filter wheel is a limited life time device. Each rotation of the filter wheel must be recorded in the instrument log book for the flight model.

6.8.2. Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.8.3. Execution: Filter Wheel Control Test

execute:.EHIST_FWL_TEST.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in operational mode KAL power line is on		Pref H4505 = 'operational'		
1	Test of filter wheel coarse command				
1.1	Command F/W to datum (tc_fw_to_datum) (tc_fw_move) Wait for event	H7608 H5600 92600	Pref H7010 = 'fw @ req pos'		
1.2	Examine HK	90000	Pref H5150 = 'seen' Pref H5265 = 0		
1.3	Command F/W off coarse sensor (tc_fw_rel_steps 1000) (tc_fw_move) Wait for event	H7606 H5600 92600	Pref H290 = 1000 (dec) Pref H7010 = 'fw @ req pos'		
1.4	Examine HK	90000	Pref H5250 = 'not seen' Pref H5150 = 'seen'		
1.5	Command F/W to coarse sensor (tc_fw_to_coarse) (tc_fw_move) Wait for event	H7609 H5600 92600	Pref H7010 = 'fw @ req pos'		
1.6	Examine HK	90000	Pref H5250 = 'seen'		
2	Test of filter wheel datum command				
2.1	Command F/W to datum (tc_fw_to_datum) (tc_fw_move) Wait for event	H7608 H5600 92600	Pref H7010 = 'fw @ req pos'		
2.2	Examine HK	90000	Pref H5150 = 'seen' Pref H5265 = 0		
3	Exit				

6.8.4. Testresult Prime Branch   EHIST_FWL_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.8.5. Testresult Redundant Branch EHIST_FWL_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.9. TestSequence 7 :   Dichroic Control Test (beam deflector)

This test is performed automatically by executing the Test Sequence:

EHIST_DIC_TEST

6.9.1.   Test Description

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).

Final State
The OM (prime or redundant) is switched on and in idle mode. The dichroic is at 'prime' interface position.

Safety precautions
This test procedure should be reviewed by OM personnel before first execution.

The Dichroic is a limited life time device. Each movement of the dichroic wheel must be recorded in the instrument log book for the flight model instrument.

6.9.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.9.3. Dichroic Control Test (beam deflector)

<div style="border:1px solid black; text-align:center">

execute:.EHIST_DIC_TEST.TS

</div>

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in an operational mode KAL power line is on OM-1 secondary rails are on		**Pref H4505 = operational**		
0.1	Ensure mode is engineering Go to idle mode Go to engineering mode	H9002 H9004	H550=0,H650 = 0 H550=0,H650 = 0		
1	Test of dichroic command rotate to redundant				
1.1	Set-up dichroic to redundant (tc_dm_direction 1,0)	H7650	Pref H370 = 1 Pref H375 = 'max by sign'		
1.2	Command dichroic to move (tc_dm_move)	H5650			
1.3	Examine TM	92600	Pref H7010 = 'Dichroic pos'		
1.4	Examine HK for steps in last movement	90000	Pref H5275 = 32 (dec)		
2	Test of dichroic command rotate to prime				
2.1	Set-up dichroic to prime (tc_dm_direction -1,0)	H7650	Pref H370 = -1 Pref H375 = 'max by sign'		
2.2	Command dichroic to move (tc_dm_move)	H5650			
2.3	Wait up to 20 seconds				
2.4	Examine TM (test for event)	92600	Pref H7010 = 'Dichroic pos'		
2.5	Examine HK	90000	Pref H5275 = -31 (dec)		
3	Ensure OM is in Idle Mode	H9002	H650 = 0		
4	Exit				

The Dichroic is a limited life time device. Each movement of the dichroic wheel must be recorded in the instrument log book for the flight model instrument.

6.9.4.   Testresult Prime Branch   EHIST_DIC_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.9.5.   Testresult Redundant Branch EHIST_DIC_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.10. TestSequence 8 :   Heater Control test

This test is performed automatically by executing the Test Sequence:

EHIST_HTR_TEST

6.10.1.   Test Description

Description
The function of the heaters is tested in operational mode.
Each of the four main heaters are cycled on/off in turn.

Initial state
The OM (prime or redundant) is switched on and in operational mode.

Final State
The OM (prime or redundant) is switched on and in operational mode.

Safety precautions
None

6.10.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> ### WARNING!
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.
Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.10.3. Execution: Heater Control test

execute:.EHIST_HTR_TEST.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in operational mode KAL power line is on		**Pref H4505 = operational**		
1	Prepare for heater switching				
1.1	Disable standard control algorithm (tc_heater_stop) Examine TM Examine HK	H6670 91100 90000			
1.2	Measure S/C +28V voltage and current		Pref H5240 = 'offoffoffoff' report: voltage and current		
1.3	Start heater contingency task	H5660			
2	Switch-on heater 1 (Main I/F) (tc_heater_config 8)	H7660	Pref H380 = 'onoffoffoff'		
2.1	Examine HK	90000	Pref H5240 = 'onoffoffoff'		
2.2	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
2.3	Compare with table 5.7-1				
2.4	Switch-off heater 1 (tc_heater_config 0)	H7660	Pref H380 = 'offoffoffoff'		
2.5	Examine HK	90000	Pref H5240 = 'offoffoffoff'		
3	Switch on heater 2 (forward tube)				
3.1	Switch-on heater 2 (tc_heater_config 4)	H7660	Pref H380 = 'offonoffoff'		
3.2	Examine HK	90000	Pref H5240 = 'offonoffoff'		
3.3	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
3.4	Compare with table 5.7-1				
3.5	Switch-off heater 2 (tc_heater_config 0)	H7660	Pref H380 = 'offoffoffoff'		
3.6	Examine HK	90000	Pref H5240 = 'offoffoffoff'		
4.	Switch on heater 3 (metering rods)				
4.1	Switch-on heater 3 (tc_heater_config 2)	H7660	Pref H380 = 'offoffonoff'		
4.2	Examine HK	90000	Pref H5240 = 'offoffonoff'		
4.3	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
4.4	Compare with table 5.7-1				
4.5	Switch-off heater 3 (tc_heater_config 0)	H7660	Pref H380 = 'offoffoffoff'		
4.6	Examine HK	90000	Pref H5240 = 'offoffoffoff'		

5	Switch on heater 4 (secondary mirror)				
5.1	Switch-on heater 4 (tc_heater_config 1)	H7660	Pref H380 = 'offoffoffon'		
5.2	Examine HK	90000	Pref H5240 = 'offoffoffon'		
5.3	Measure S/C +28V voltage and current		S/C procedure report: voltage and current		
5.4	Compare with table 5.7-1				
5.5	Switch-off heater 4 (tc_heater_config 0)	H7660	Pref H380 = 'offoffoffoff'		
5.6	Examine HK	90000	Pref H5240 = 'offoffoffoff'		
6	Disable heater switching Stop heater contingency task	H6660			
6.1	**Measure S/C +28V voltage and current**				
6.2	**Compare with table 5.7-1**		**(heaters disabled)**		
6.3	Enable standard control algorithm (tc_heater_start)	H5670			
7	Exit				

Heater	+28V Current
1 (Main Interface)	1440mA +/- 100mA
2 (Forward tube)	1740mA +/- 100mA
3 (Metering Rods)	1060mA +/- 100mA
4 (Secondary Mirror)	950mA +/- 100mA
Disable Heater Algorithm	810mA +/- 100mA

Table 5.7-1 Heater switching power profile

6.10.4. Testresult Prime Branch   EHIST_HTR_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.10.5. Testresult Redundant Branch EHIST_HTR_TEST

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.11. TestSequence 9 : Image Acquisition Test - Multiple Window (High Voltage OFF)

This test is performed automatically by executing the Test Sequence:

EHIST_IMG_MULTI

6.11.1. Test Description

Description
The function of the OM Image acquisition is tested in operational mode.
A full image will be acquired and dumped to the instrument workstation. Only those areas enabled in the window table should contain events. ***This version of the multiple window test does not make use of High Voltage.***

Initial state
The OM (prime or redundant) is switched on and in an operational mode.
OM-1 secondary rails are switched on.

Final State
The OM (prime or redundant) is switched on and in idle mode.

Safety precautions
The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

6.11.2. Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.

Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.11.3. Execution: Image Acquisition Test - Multiple Window

execute:.EHIST_IMG_MULTI.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in engineering mode KAL power line is on OM-1 secondary rails are on		**Pref H4505 = operational**		
1	Complete DPU reset				
1.1	Send DPU reset	H7201			
1.2	**Check TM received**	92201	DA_DPU_BOOT_READY		
1.3	Enable DPUOS code	H7202			
1.4	**Check TM received**	92202	DPU OS Ready		
1.5	Enable red dsp then wait 10 seconds	H7207	Pref H522 = 'Red' Pref H16 = 'Enabled'		
1.6	Enable blue 1 dsp then wait 10 seconds	H7207	Pref H522 = 'Blue1' Pref H16 = 'Enabled'		
1.7	Enable blue 2 dsp then wait 10 seconds	H7207	Pref H522 = 'Blue2' Pref H16 = 'Enabled'		
1.8	**Set Kling_on**	**H7206**	**Pref H523 = 'Blue2' (Alias 9203)**		
1.9	Init DPU	H7248			
1.10	Check for event	92210	DA_EOT_INIT_DPU		
1.11	**Enable Verbose**	**H7244**	Pref H760='3' (Alias 9240) Pref H16 = '1' (Alias 9010)		
2	Prepare DPU for image acquisition				
2.1	Ensure OM is in idle mode (tc_mode 2)	H9002	Pref H650=0 **H5395 = 'Idle'**		
2.2	Set exposure number	H7238	Pref H530 = 1		
3	Prepare BPE for image acquisition				
3.1	Set acquisition mode (High Res, Windowed)	H7130	Pref H110 = 'Hi Res Win'		
3.2	Examine HK	90000	Pref H5215 = 'Hi Res Win'		
3.3	Set event threshold	H7131	Pref H120 = 2		
3.4	Specify centroid channel boundaries	H7100	Table 5.8-1		
3.5	Load channel boundaries Wait for event (2.5 minutes)	H5100 92100	H7000 = 'cen tab load'		
3.6	Specify window params Load window look-up table	H7110 H5110	Table 5.8-2		
3.7	wait for event (1 minute)	92100	H7000 = 'win tab load'		
3.8	Ensure Frame Tags disabled	H7135	H16 = 'Disabled'		

4	Place Filter Wheel in Blocked Position. Ensure coarse and fine sensors have correct values				
4.1	(tc_fw_coarse_sensor_current 4	H7600	H300 = 4 (56 mA)		
4.2	tc_fw_fine_sensor_current 9)	H7601	H310 = 9 (25 mA)		
4.3	Specify filter wheel to datum	H7608			
4.4	Move it there.	H5600			
	Await Event	92600	H7010 = 'fw @ req pos'		
4.5	Specify move to blocked (Filt. = 0)	H7604	H280 = 'Blocked'		
4.6	Move it there	H5600			
	Await Event	92600	H7010 = 'fw @ req pos'		
5	Acquire image.				
5.1	Ensure we are in engineering mode (tc_mode 4).	H9004	H550=0,H650 = 0		
5.2	Turn on Flood LED (level =3).	H7134	**H140** = 3 (4 uA)		
5.3	Set DPU frame time to 5 mins. (ic_set_frame_time)	H7236	**H710 = 307200 (300*1024)**		
5.4	Start sending events to DPU.	H5130			
5.5	Start full image eng integration (tc_enbl_eng 1,4). Wait 5 minutes to acquire data	H7254	H880 = 'Full hi res'		
	Await Event (DA_ENDOF_EXP).	92205			
5.6	Stop sending events to DPU (failsafe command).	H6130			
5.7	Disable Flood LED (level=0)	H7134	**H140** = 0 (0 mA)		
6	Await Dumping of Engineering Image (2.5 hours)				
6.1	Await Event DA_SENT_CMPRSSQ	92217	**16 packets**		
6.2	Await Event DA_COMPLETE_EXP				
		92209			
7	Exit				

Description	Pref	Value
Enable/Disable Verification	H10	'Enable'
X Centroid Table Boundary 0	H20	-1000
X Centroid Table Boundary 1	H21	-750
X Centroid Table Boundary 2	H22	-500
X Centroid Table Boundary 3	H23	-250
X Centroid Table Boundary 4	H24	0
X Centroid Table Boundary 5	H25	250
X Centroid Table Boundary 6	H26	500
X Centroid Table Boundary 7	H27	750
X Centroid Table Boundary 8	H28	1000
Y Centroid Table Boundary 0	H30	-1000
Y Centroid Table Boundary 1	H31	-750
Y Centroid Table Boundary 2	H32	-500
Y Centroid Table Boundary 3	H33	-250
Y Centroid Table Boundary 4	H34	0
Y Centroid Table Boundary 5	H35	250
Y Centroid Table Boundary 6	H36	500
Y Centroid Table Boundary 7	H37	750
Y Centroid Table Boundary 8	H38	1000

Table 5.8-1 Centroid Table Boundaries

Description		Pref	Value
Enable/Disable Verification = 1/0		H10	'Enable'
No of Windows		H40	2
Xlow	Parameters for	H50	64
Ylow	Window 1	H51	15
Xsize	(Units are CCD pixels)	H52	64
Ysize		H53	64
Xlow	Parameters for	H54	216
Ylow	Window 2	H55	77
Xsize	(Units are CCD pixels)	H56	64
Ysize		H57	64
	All remaining parameters	H58-H109	0

Table 5.8-2 Window Parameters

6.11.4. Testresult Prime Branch   EHIST_IMG_MULTI

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.11.5. Testresult Redundant Branch EHIST_IMG_MULTI

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.12. TestSequence 10 : Image Acquisition Test - Full Frame (High Voltage OFF)

This test is performed automatically by executing the Test Sequence:

EHIST_IMG_FULL

6.12.1. Test Description

Note
This script has *originally* been designed for sole use during EMC testing of the instrument *but will now be used as part of the basic IST*.

Description
The High voltage will not be used during this test. Data will be obtained by artificially lowering the detector threshold to 2. System noise will provide the data.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.
It is assumed for the purposes of this test that the DPU has had its operating system code already loaded (this should be the case if the KAL has been left on)

Final state
The OM (prime or redundant) is switched on and in engineering mode.

Safety precautions
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

6.12.2. Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> ### WARNING!
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.

Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.12.3. Execution: Image Acquisition Test - Full Frame

execute:.EHIST_IMG_FULL.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on and in engineering mode KAL power line is on OM-1 secondary rails are on		**Pref H4505 = operational**		
1	Complete DPU reset				
1.1	Send DPU reset	H7201			
1.2	**Check TM received**	92201	DA_DPU_BOOT_READY		
1.3	Enable DPUOS code	H7202			
1.4	**Check TM received**	92202	DPU OS Ready		
1.5	Enable red dsp then wait 10 seconds	H7207	Pref H522 = 'Red' Pref H16 = 'Enabled'		
1.6	Enable blue 1 dsp then wait 10 seconds	H7207	Pref H522 = 'Blue1' Pref H16 = 'Enabled'		
1.7	Enable blue 2 dsp then wait 10 seconds	H7207	Pref H522 = 'Blue2' Pref H16 = 'Enabled'		
1.8	**Set Kling_on**	**H7206**	**Pref H523 = 'Blue2' (Alias 9203)**		
1.9	Init DPU	H7248			
1.10	Check for event	92210	DA_EOT_INIT_DPU		
1.11	**Enable Verbose**	**H7244**	Pref H760='3' (Alias 9240) Pref H16 = '1' (Alias 9010)		
2	Prepare DPU for image acquisition				
2.1	Ensure OM is in idle mode (tc_mode 2)	H9002	Pref H650=0 **H5395 = 'Idle'**		
2.2	Set exposure number	H7238	Pref H530 = 1		
3	Prepare BPE for image acquisition				
3.1	Set acquisition mode (High Res, Full Frame)	H7130	Pref H110 = 'Hi Res Full'		
3.2	Examine HK	90000	Pref H5215 = 'Hi Res Full'		
3.3	Set event threshold	H7131	Pref H120 = 2		
3.4	Specify centroid channel boundaries	H7100	Table 5.8-1		
3.5	Load channel boundaries Wait for event (2.5 minutes)	H5100 92100	H7000 = 'cen tab load'		
3.6	Specify window params Load window look-up table	H7110	Table 5.11-1		
3.7	wait for event (1 minute)	H5110	H7000 = 'win tab load'		
3.8	Ensure Frame Tags disabled	H7135	H16 = 'disabled'		

4	Place Filter Wheel in Blocked Position. Ensure coarse and fine sensors have correct values				
4.1	(tc_fw_coarse_sensor_current 4	H7600	H300 = 4 (56 mA)		
4.2	tc_fw_fine_sensor_current 9)	H7601	H310 = 9 (25mA)		
4.3	Specify filter wheel to datum	H7608			
4.4	Move it there.	H5600			
	Await Event	92600	H7010 = 'fw @ req pos'		
4.5	Specify move to blocked (Filt. = 0)	H7604	H280 = 'Blocked'		
4.6	Move it there	H5600			
	Await Event	92600	H7010 = 'fw @ req pos'		
5	Acquire image.				
5.1	Ensure we are in engineering mode (tc_mode 4).	H9004	H550=0,H650 = 0		
5.3	Set DPU frame time to 5 mins. (ic_set_frame_time)	H7236	**H710 = 307200 (300*1024)**		
5.4	Start sending events to DPU.	H5130			
5.5	Start full image eng integration (tc_enbl_eng 1,4).	H7254	H880 = 'Full hi res'		
	Wait 5 minutes to acquire data Await Event (DA_ENDOF_EXP).	92205			
5.6	Stop sending events to DPU (failsafe command).	H6130			
6	Await Dumping of Engineering Image (2.5 hours)				
6.1	Await Event DA_SENT_CMPRSSQ	92217	**16 packets**		
6.2	Await Event DA_COMPLETE_EXP	92209			
7	Exit				

Description		Pref	Value	
			Prime	**Redundant**
Enable/Disable Verification = 1/0		H10	'Enable'	'Enable'
No of Windows		H40	1	1
Xlow	**Parameters for**	H50	52	64
Ylow	**Window 1**	H51	27	15
Xsize	**(Units are CCD pixels)**	H52	256	256
Ysize		H53	256	256
	All remaining parameters	H54-H109	0	0

Table 5.11-1 Window Parameters

6.12.4. Testresult Prime Branch   EHIST_IMG_FULL

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.12.5. Testresult Redundant Branch EHIST_IMG_FULL

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.13. TestSequence 11 : Image Acquisition Test
- Multiple Window (High Voltage ON)

This test is performed automatically by executing the Test Sequence:

EHIST_MULTI_HV

6.13.1. Test Description

Description
The function of the OM Image acquisition is tested in operational mode.
A full image will be acquired and dumped to the instrument workstation. Only those areas enabled in the window table should contain events.

Initial state
The OM (prime or redundant) is switched on and in an operational mode.
OM-1 secondary rails are switched on.

Final State
The OM (prime or redundant) is switched on and in idle mode.

Safety precautions
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

Under no circumstances should the instrument main power be switched off without first switching off the HVU using the script.

6.13.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.

Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.13.3.   Execution: Image Acquisition Test - Multiple Window

execute:.EHIST_MULTI_HV.TS

6.13.4. Testresult Prime Branch   EHIST_MULTI_HV

Date	Expected Time	Start Time	End Time	Test Executed
	1 h 40 min			**OK** **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.9.5. Testresult Redundant Branch EHIST_MULTI_HV

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.14. TestSequence 12 : Image Acquisition Test - Full Frame (High Voltage ON)

This test is performed automatically by executing the Test Sequence:

EHIST_FULL_HV

6.14.1.　Test Description

Description
The function of the OM Image acquisition is tested in engineering mode.
A full frame image will be acquired and dumped to the instrument work station. The filter wheel is commanded to the blocked position and the flood LED's will be used to generate events.

This script should be used in addition to tables 5.9-2 and 5.9-3 to commission the high voltage unit. Four iterations of instrument HVU being switched on and an image acquired will be needed. For each iteration, the relevant HVU operational voltages should be used (these voltages are the target voltages, the HVU must be switched on following the normal algorithm to permit these voltages to be reached). An MSSL representative will be responsible for commencing with each iteration after first having examined the data for safe background event levels.

Initial state
The OM (prime or redundant) is switched on and in an operational mode (safe, idle, science or engineering).
OM-1 secondary rails are switched on.

Final state
The OM (prime or redundant) is switched on and in engineering mode.

Safety precautions
Operation of the high voltage unit must only be performed when OM personnel are present and only in a controlled environment - irreparable damage of the detector can occur.

The Filter wheel is a limited life time device. All movements of the filter wheel (such as occur in this test) must be recorded in the instrument log book for the flight model.

6.14.2. Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> ### WARNING!
> In all cases, when an error is encountered, authorised personnel
> (e.g. Test Manager) **MUST** be consulted, before the test is
> resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.

Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.14.3. Execution: Image Acquisition Test - Full Frame

execute:.EHIST_FULL_HV.TS

6.14.4. Testresult Prime Branch   EHIST_FULL_HV

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

6.14.5. Testresult Redundant Branch EHIST_FULL_HV

Date	Expected Time	Start Time	End Time	Test Executed
				OK **NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.15. TestSequence 13 : Switch -OFF

This test is performed automatically by executing the Test Sequence:

EHMOD_PWR_OFF

6.15.1.   Test Description

Description
Mode and state are checked and the appropriate procedure is followed to switch-off in an orderly way.

Initial state
The OM (prime or redundant) is switched on.

Final state
The OM (prime or redundant) is switched off. The KAL power lines may be left on.

Safety precautions
none

6.15.2.   Error Handling

Verification of tests is done automatically by the Test Sequence. In case of error, information on the error is logged in the TSLOG in the form

>>>> ERROR: <Error Message>

A message is displayed in both the TS-Log Window and the TS-Control Window. The Test Sequence is 'HALT'ed for the operator to indicate the action to be taken (Continue or Abort).

> **WARNING!**
> In all cases, when an error is encountered, authorised personnel (e.g. Test Manager) **MUST** be consulted, before the test is resumed or aborted.

Correct status manually or stop TS

To continue from this point the operator has to click the 'CONT' button. No corrective action is done by the Test Sequence when continued unless explicitly stated in the message.

Any abortion of the Test Sequence will leave the Spacecraft in an undefined state.

6.15.3.   Execution: Switch - OFF

execute:.EHMOD_PWR_OFF.TS

Step	Action	TC/TM	Remarks	Pass	Notes
0	Initial state: OM switched on KAL power line is on				
1	Check ICU state if mode = Operational = Basic		H5405 goto step 2 goto step 3		
2.0	If HV enabled: Ramp down HV (Warning, these commands are hazardous)	90000	H5145 = 1 = 'Enabled'		
2.1	Specify Vcathode Ramp.	H7140	H150='cathode',H160=0, H175='off'		
2.2	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'cathode ok'		
2.3	Specify Vmcp1 Ramp.	H7140	H150='mcp1',H160=0, H175='off'		
2.4	Perform Ramp. Await Event.	H5140 92100	 H7000 = 'mcp1 ok'		
2.5	Specify Vmcp23 Ramp.	H7140	H150='mcp23',H160=0, H175='off'		
2.6	Perform Ramp. Await Event. Examine HK	H5140 92100 90000	 H7000 = 'mcp23 ok' H5145='Disabled'		
3.1 3.2	Switch off OM-1 secondary rails Disable heater algorithm	H6690 H6670			
4 4.1 4.2	**Stop ICU** **Disable Watchdog for RBI** **suspnd** Send RBI suspend command	 **H6510** **D7203**			
5	Switch-off +28V power		S/C procedure report: voltage and current		
6	Switch-off KAL		S/C procedure report: voltage and current		
7	Exit				

6.15.4. Testresult Prime Branch EHMOD_PWR_OFF

Date	Expected Time	Start Time	End Time	Test Executed
	5 min			**OK NOK**

Comments:

This Test Case has been successfully performed, all open issues are covered by NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	**Date:**	**Date:**
Sign.:	**Sign.:**	**Sign.:**

6.15.5. Testresult Redundant Branch EHMOD_PWR_OFF

Date	Expected Time	Start Time	End Time	Test Executed
				OK NOK

Comments:

This Test Case has been successfully performed, all open issues are covered by
NCR's, SCR's or Procedure Variations. All required Test Printouts are annexed
to the Procedure.

S/S Resp. - Test Cond.	PA	ESA Representative
Date:	Date:	Date:
Sign.:	Sign.:	Sign.:

7.   CONTINGENCY PROCEDURES

ERROR! NOT A VALID FILENAME.

8. S/C CONFIGURATION STATUS LIST/ REFERENCE

9. TEST SIGN-OFF SHEET

Integrated System Test for *XMM* Experiment

(Shaded area MUST be filled)

Test Manager:	Name:	Date:	Signature:
Test Conductor-1:	Name:	Date:	Signature:
Test Conductor-2:	Name:	Date:	Signature:
Test Conductor-3:	Name:	Date:	Signature:
Test Conductor-4:	Name:	Date:	Signature:
Experiment Representative	Name:	Date:	Signature:
PA Representative:	Name:	Date.	Signature:
ESA Representative:	Name:	Date.	Signature:

Test Summary

Name:	Date:	Signature:

10. ANNEX 1 TS LOG FILE PRINTS